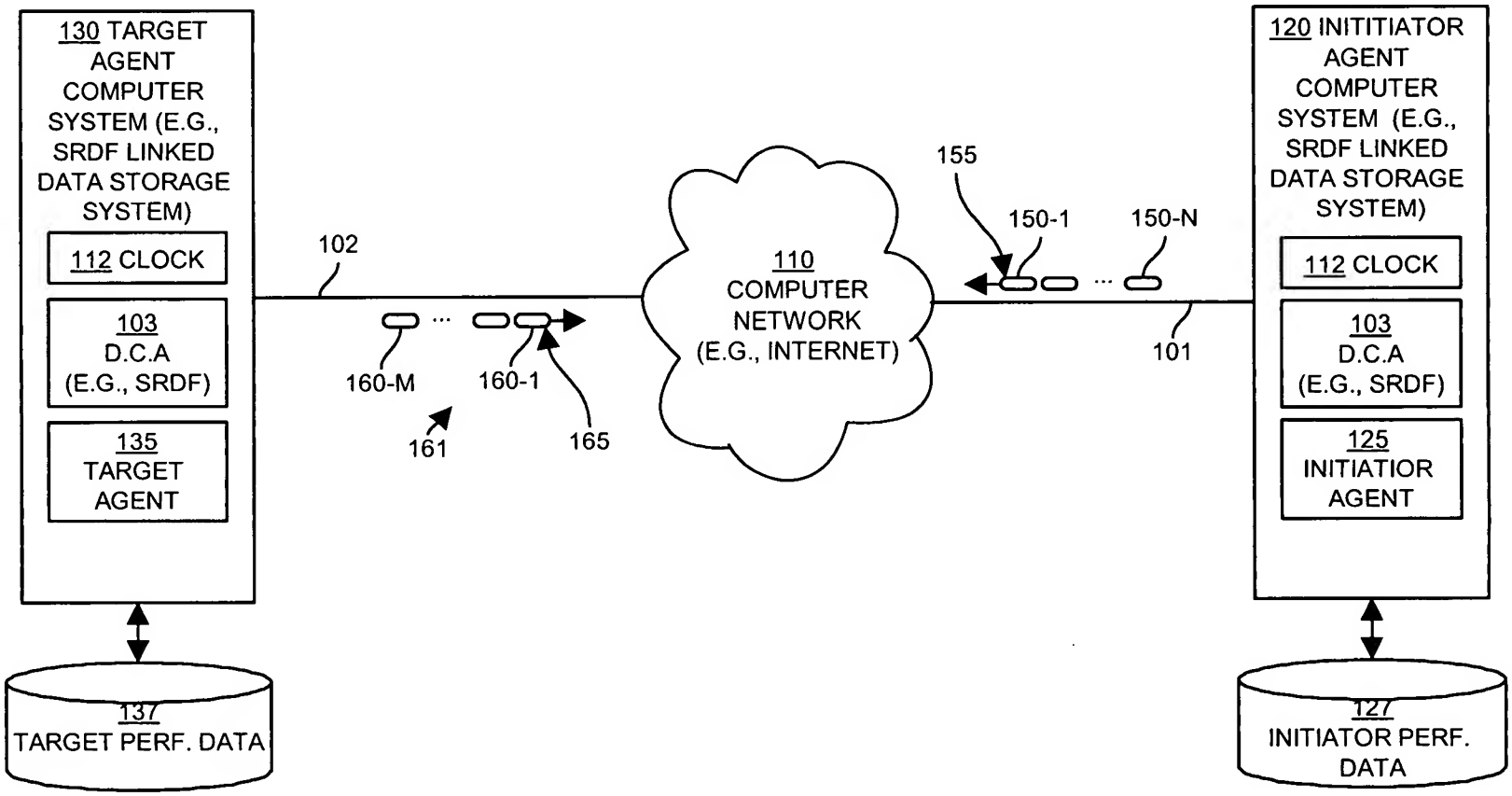
130 TARGET AGENT COMPUTER SYSTEM (E.G., SRDF LINKED DATA STORAGE SYSTEM)
112 CLOCK
103 D.C.A (E.G., SRDF)
135 TARGET AGENT
137 TARGET PERF. DATA
102
160-M
160-1
161
165
110 COMPUTER NETWORK (E.G., INTERNET)
155
150-1
150-N
101
120 INITITIATOR AGENT COMPUTER SYSTEM (E.G., SRDF LINKED DATA STORAGE SYSTEM)
112 CLOCK
103 D.C.A (E.G., SRDF)
125 INITIATIOR AGENT
127 INITIATOR PERF. DATA
100

FIG. 1

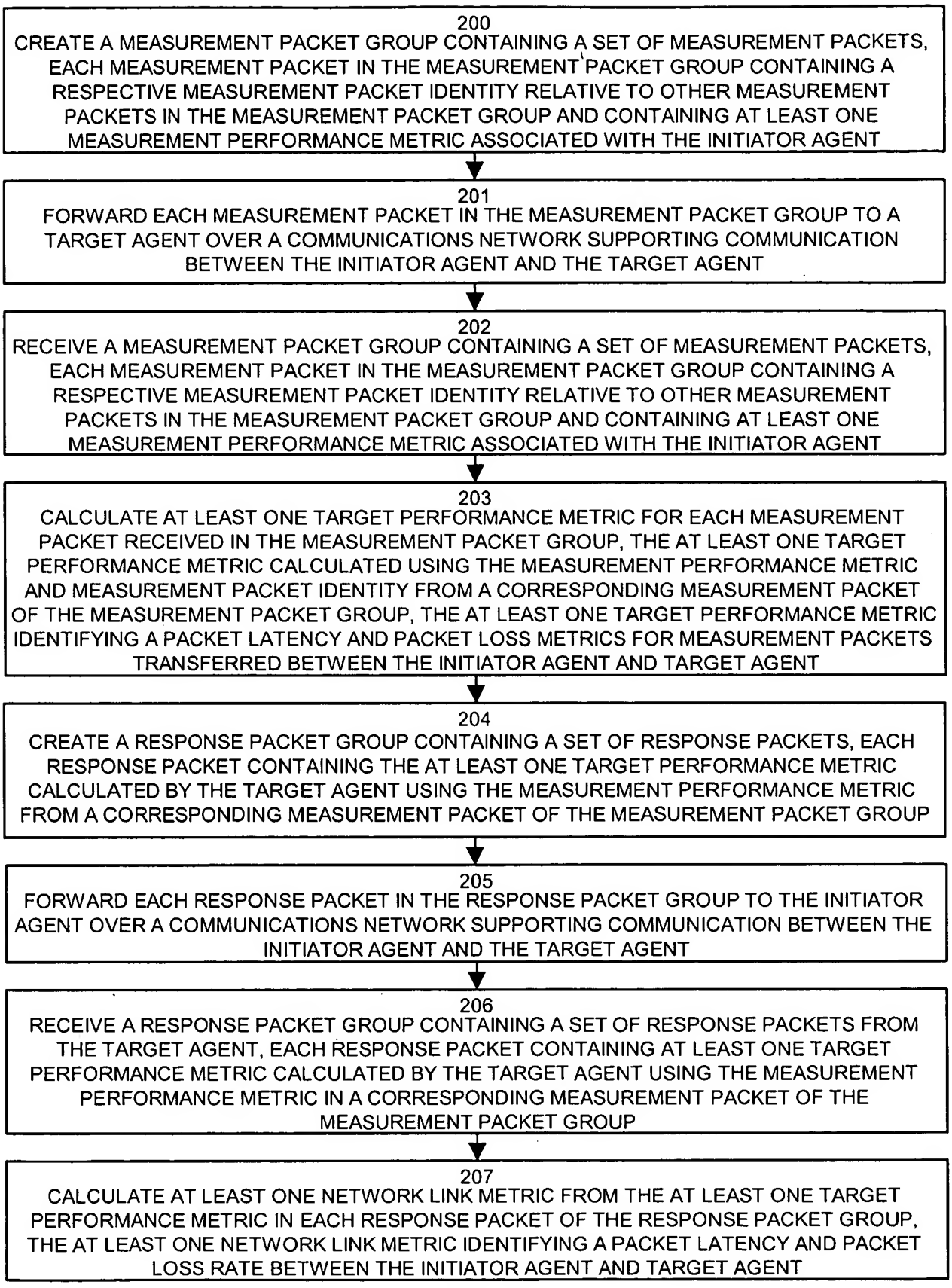
200
CREATE A MEASUREMENT PACKET GROUP CONTAINING A SET OF MEASUREMENT PACKETS, EACH MEASUREMENT PACKET IN THE MEASUREMENT PACKET GROUP CONTAINING A RESPECTIVE MEASUREMENT PACKET IDENTITY RELATIVE TO OTHER MEASUREMENT PACKETS IN THE MEASUREMENT PACKET GROUP AND CONTAINING AT LEAST ONE MEASUREMENT PERFORMANCE METRIC ASSOCIATED WITH THE INITIATOR AGENT
201
FORWARD EACH MEASUREMENT PACKET IN THE MEASUREMENT PACKET GROUP TO A TARGET AGENT OVER A COMMUNICATIONS NETWORK SUPPORTING COMMUNICATION BETWEEN THE INITIATOR AGENT AND THE TARGET AGENT
202
RECEIVE A MEASUREMENT PACKET GROUP CONTAINING A SET OF MEASUREMENT PACKETS, EACH MEASUREMENT PACKET IN THE MEASUREMENT PACKET GROUP CONTAINING A RESPECTIVE MEASUREMENT PACKET IDENTITY RELATIVE TO OTHER MEASUREMENT PACKETS IN THE MEASUREMENT PACKET GROUP AND CONTAINING AT LEAST ONE MEASUREMENT PERFORMANCE METRIC ASSOCIATED WITH THE INITIATOR AGENT
203
CALCULATE AT LEAST ONE TARGET PERFORMANCE METRIC FOR EACH MEASUREMENT PACKET RECEIVED IN THE MEASUREMENT PACKET GROUP, THE AT LEAST ONE TARGET PERFORMANCE METRIC CALCULATED USING THE MEASUREMENT PERFORMANCE METRIC AND MEASUREMENT PACKET IDENTITY FROM A CORRESPONDING MEASUREMENT PACKET OF THE MEASUREMENT PACKET GROUP, THE AT LEAST ONE TARGET PERFORMANCE METRIC IDENTIFYING A PACKET LATENCY AND PACKET LOSS METRICS FOR MEASUREMENT PACKETS TRANSFERRED BETWEEN THE INITIATOR AGENT AND TARGET AGENT
204
CREATE A RESPONSE PACKET GROUP CONTAINING A SET OF RESPONSE PACKETS, EACH RESPONSE PACKET CONTAINING THE AT LEAST ONE TARGET PERFORMANCE METRIC CALCULATED BY THE TARGET AGENT USING THE MEASUREMENT PERFORMANCE METRIC FROM A CORRESPONDING MEASUREMENT PACKET OF THE MEASUREMENT PACKET GROUP
205
FORWARD EACH RESPONSE PACKET IN THE RESPONSE PACKET GROUP TO THE INITIATOR AGENT OVER A COMMUNICATIONS NETWORK SUPPORTING COMMUNICATION BETWEEN THE INITIATOR AGENT AND THE TARGET AGENT
206
RECEIVE A RESPONSE PACKET GROUP CONTAINING A SET OF RESPONSE PACKETS FROM THE TARGET AGENT, EACH RESPONSE PACKET CONTAINING AT LEAST ONE TARGET PERFORMANCE METRIC CALCULATED BY THE TARGET AGENT USING THE MEASUREMENT PERFORMANCE METRIC IN A CORRESPONDING MEASUREMENT PACKET OF THE MEASUREMENT PACKET GROUP
207
CALCULATE AT LEAST ONE NETWORK LINK METRIC FROM THE AT LEAST ONE TARGET PERFORMANCE METRIC IN EACH RESPONSE PACKET OF THE RESPONSE PACKET GROUP, THE AT LEAST ONE NETWORK LINK METRIC IDENTIFYING A PACKET LATENCY AND PACKET LOSS RATE BETWEEN THE INITIATOR AGENT AND TARGET AGENT

FIG. 2

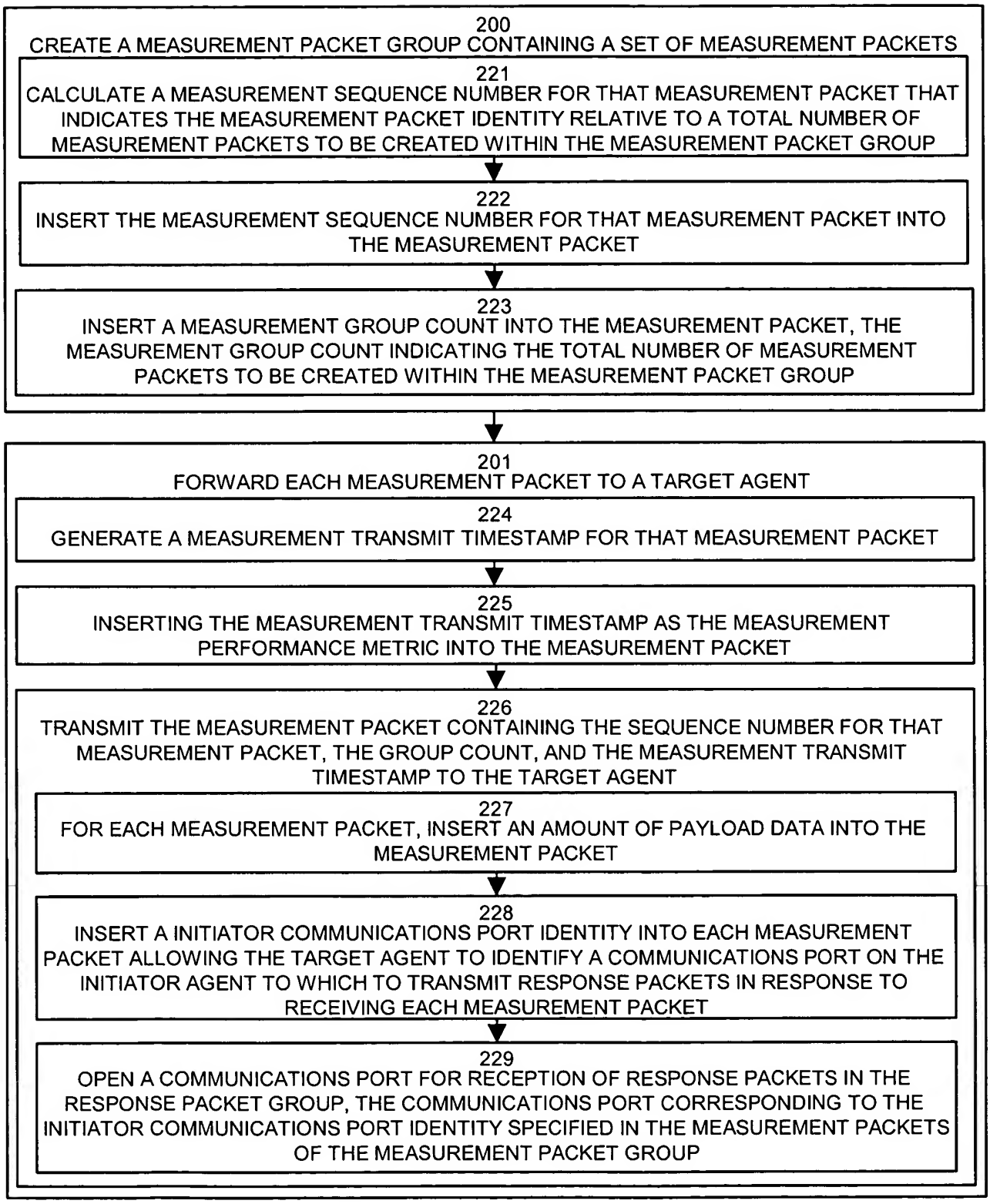
200
CREATE A MEASUREMENT PACKET GROUP CONTAINING A SET OF MEASUREMENT PACKETS
221
CALCULATE A MEASUREMENT SEQUENCE NUMBER FOR THAT MEASUREMENT PACKET THAT INDICATES THE MEASUREMENT PACKET IDENTITY RELATIVE TO A TOTAL NUMBER OF MEASUREMENT PACKETS TO BE CREATED WITHIN THE MEASUREMENT PACKET GROUP
222
INSERT THE MEASUREMENT SEQUENCE NUMBER FOR THAT MEASUREMENT PACKET INTO THE MEASUREMENT PACKET
223
INSERT A MEASUREMENT GROUP COUNT INTO THE MEASUREMENT PACKET, THE MEASUREMENT GROUP COUNT INDICATING THE TOTAL NUMBER OF MEASUREMENT PACKETS TO BE CREATED WITHIN THE MEASUREMENT PACKET GROUP
201
FORWARD EACH MEASUREMENT PACKET TO A TARGET AGENT
224
GENERATE A MEASUREMENT TRANSMIT TIMESTAMP FOR THAT MEASUREMENT PACKET
225
INSERTING THE MEASUREMENT TRANSMIT TIMESTAMP AS THE MEASUREMENT PERFORMANCE METRIC INTO THE MEASUREMENT PACKET
226
TRANSMIT THE MEASUREMENT PACKET CONTAINING THE SEQUENCE NUMBER FOR THAT MEASUREMENT PACKET, THE GROUP COUNT, AND THE MEASUREMENT TRANSMIT TIMESTAMP TO THE TARGET AGENT
227
FOR EACH MEASUREMENT PACKET, INSERT AN AMOUNT OF PAYLOAD DATA INTO THE MEASUREMENT PACKET
228
INSERT A INITIATOR COMMUNICATIONS PORT IDENTITY INTO EACH MEASUREMENT PACKET ALLOWING THE TARGET AGENT TO IDENTIFY A COMMUNICATIONS PORT ON THE INITIATOR AGENT TO WHICH TO TRANSMIT RESPONSE PACKETS IN RESPONSE TO RECEIVING EACH MEASUREMENT PACKET
229
OPEN A COMMUNICATIONS PORT FOR RECEPTION OF RESPONSE PACKETS IN THE RESPONSE PACKET GROUP, THE COMMUNICATIONS PORT CORRESPONDING TO THE INITIATOR COMMUNICATIONS PORT IDENTITY SPECIFIED IN THE MEASUREMENT PACKETS OF THE MEASUREMENT PACKET GROUP

FIG. 3

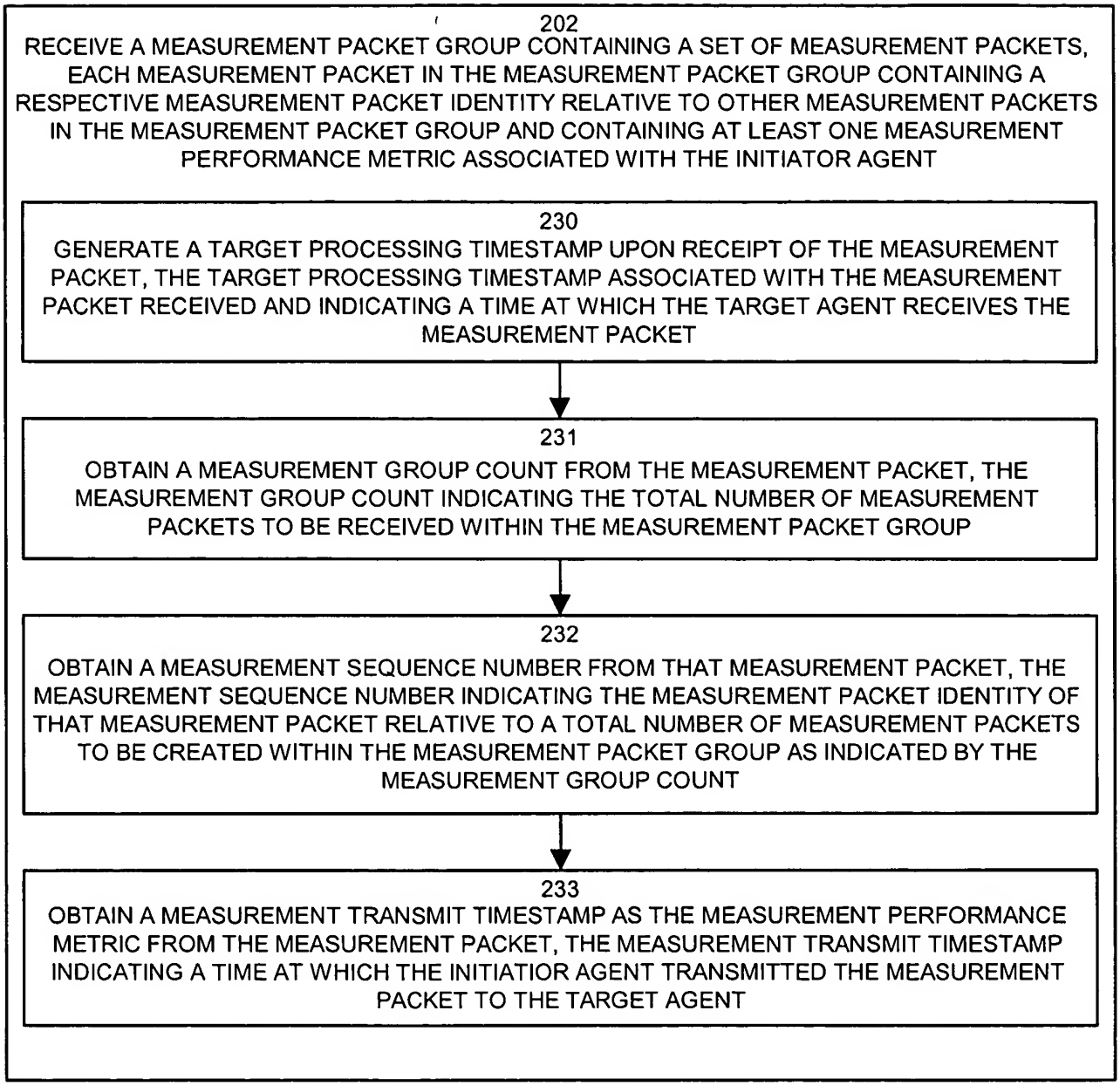
202
RECEIVE A MEASUREMENT PACKET GROUP CONTAINING A SET OF MEASUREMENT PACKETS, EACH MEASUREMENT PACKET IN THE MEASUREMENT PACKET GROUP CONTAINING A RESPECTIVE MEASUREMENT PACKET IDENTITY RELATIVE TO OTHER MEASUREMENT PACKETS IN THE MEASUREMENT PACKET GROUP AND CONTAINING AT LEAST ONE MEASUREMENT PERFORMANCE METRIC ASSOCIATED WITH THE INITIATOR AGENT
230
GENERATE A TARGET PROCESSING TIMESTAMP UPON RECEIPT OF THE MEASUREMENT PACKET, THE TARGET PROCESSING TIMESTAMP ASSOCIATED WITH THE MEASUREMENT PACKET RECEIVED AND INDICATING A TIME AT WHICH THE TARGET AGENT RECEIVES THE MEASUREMENT PACKET
231
OBTAIN A MEASUREMENT GROUP COUNT FROM THE MEASUREMENT PACKET, THE MEASUREMENT GROUP COUNT INDICATING THE TOTAL NUMBER OF MEASUREMENT PACKETS TO BE RECEIVED WITHIN THE MEASUREMENT PACKET GROUP
232
OBTAIN A MEASUREMENT SEQUENCE NUMBER FROM THAT MEASUREMENT PACKET, THE MEASUREMENT SEQUENCE NUMBER INDICATING THE MEASUREMENT PACKET IDENTITY OF THAT MEASUREMENT PACKET RELATIVE TO A TOTAL NUMBER OF MEASUREMENT PACKETS TO BE CREATED WITHIN THE MEASUREMENT PACKET GROUP AS INDICATED BY THE MEASUREMENT GROUP COUNT
233
OBTAIN A MEASUREMENT TRANSMIT TIMESTAMP AS THE MEASUREMENT PERFORMANCE METRIC FROM THE MEASUREMENT PACKET, THE MEASUREMENT TRANSMIT TIMESTAMP INDICATING A TIME AT WHICH THE INITIATIOR AGENT TRANSMITTED THE MEASUREMENT PACKET TO THE TARGET AGENT

FIG. 4

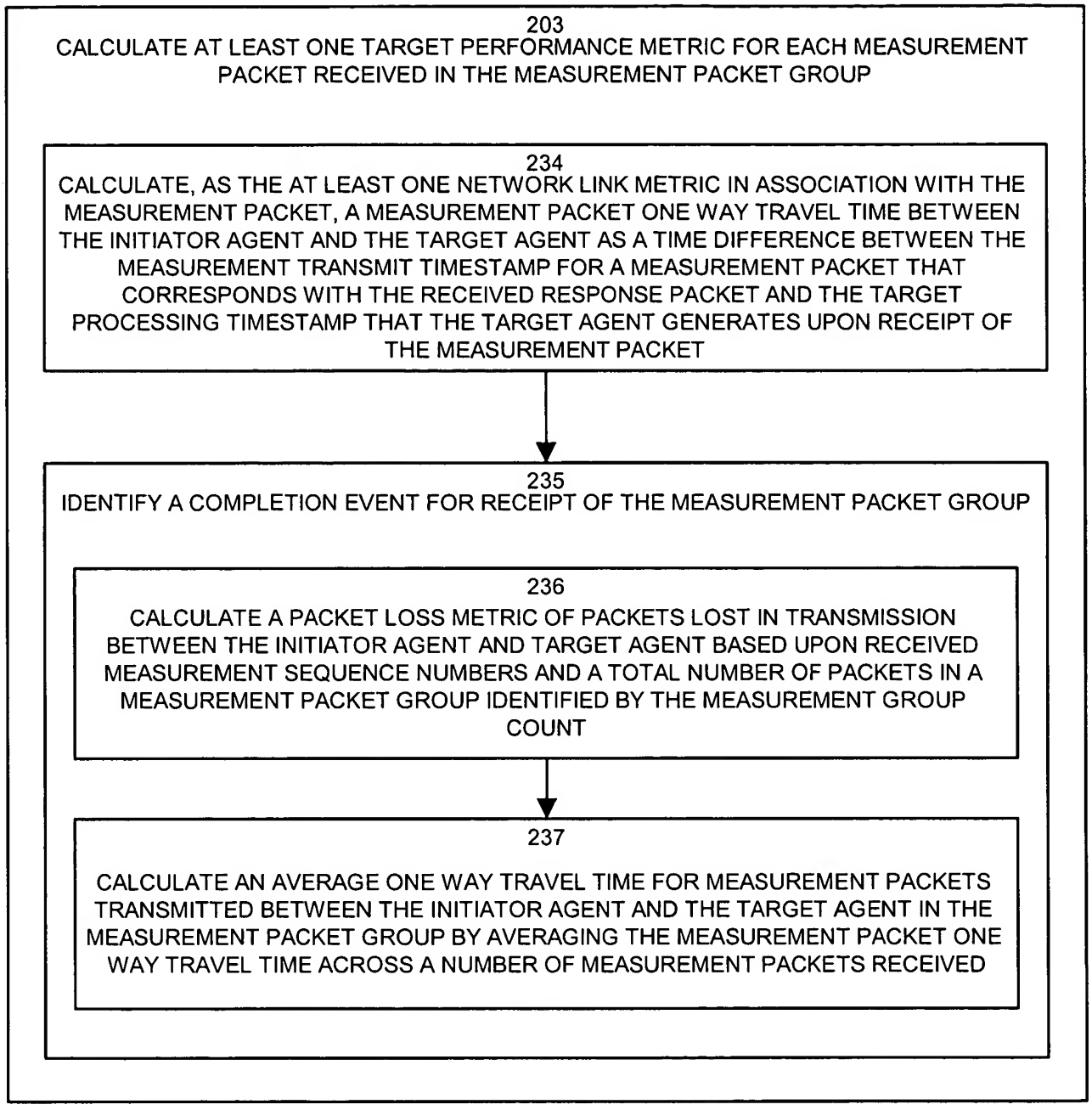
203
CALCULATE AT LEAST ONE TARGET PERFORMANCE METRIC FOR EACH MEASUREMENT PACKET RECEIVED IN THE MEASUREMENT PACKET GROUP
234
CALCULATE, AS THE AT LEAST ONE NETWORK LINK METRIC IN ASSOCIATION WITH THE MEASUREMENT PACKET, A MEASUREMENT PACKET ONE WAY TRAVEL TIME BETWEEN THE INITIATOR AGENT AND THE TARGET AGENT AS A TIME DIFFERENCE BETWEEN THE MEASUREMENT TRANSMIT TIMESTAMP FOR A MEASUREMENT PACKET THAT CORRESPONDS WITH THE RECEIVED RESPONSE PACKET AND THE TARGET PROCESSING TIMESTAMP THAT THE TARGET AGENT GENERATES UPON RECEIPT OF THE MEASUREMENT PACKET
235
IDENTIFY A COMPLETION EVENT FOR RECEIPT OF THE MEASUREMENT PACKET GROUP
236
CALCULATE A PACKET LOSS METRIC OF PACKETS LOST IN TRANSMISSION BETWEEN THE INITIATOR AGENT AND TARGET AGENT BASED UPON RECEIVED MEASUREMENT SEQUENCE NUMBERS AND A TOTAL NUMBER OF PACKETS IN A MEASUREMENT PACKET GROUP IDENTIFIED BY THE MEASUREMENT GROUP COUNT
237
CALCULATE AN AVERAGE ONE WAY TRAVEL TIME FOR MEASUREMENT PACKETS TRANSMITTED BETWEEN THE INITIATOR AGENT AND THE TARGET AGENT IN THE MEASUREMENT PACKET GROUP BY AVERAGING THE MEASUREMENT PACKET ONE WAY TRAVEL TIME ACROSS A NUMBER OF MEASUREMENT PACKETS RECEIVED

FIG. 5

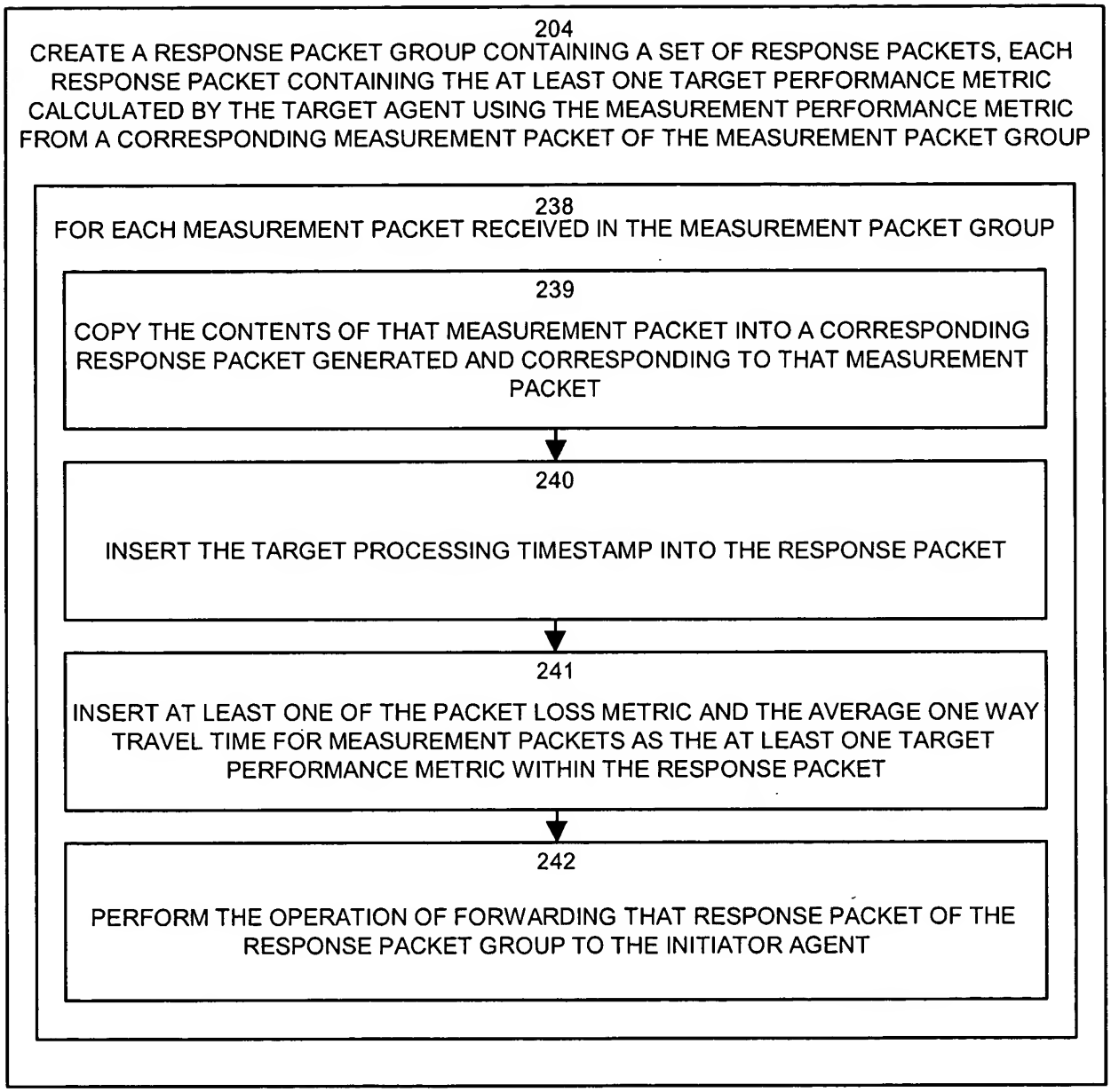
204
CREATE A RESPONSE PACKET GROUP CONTAINING A SET OF RESPONSE PACKETS, EACH RESPONSE PACKET CONTAINING THE AT LEAST ONE TARGET PERFORMANCE METRIC CALCULATED BY THE TARGET AGENT USING THE MEASUREMENT PERFORMANCE METRIC FROM A CORRESPONDING MEASUREMENT PACKET OF THE MEASUREMENT PACKET GROUP
238
FOR EACH MEASUREMENT PACKET RECEIVED IN THE MEASUREMENT PACKET GROUP
239
COPY THE CONTENTS OF THAT MEASUREMENT PACKET INTO A CORRESPONDING RESPONSE PACKET GENERATED AND CORRESPONDING TO THAT MEASUREMENT PACKET
240
INSERT THE TARGET PROCESSING TIMESTAMP INTO THE RESPONSE PACKET
241
INSERT AT LEAST ONE OF THE PACKET LOSS METRIC AND THE AVERAGE ONE WAY TRAVEL TIME FOR MEASUREMENT PACKETS AS THE AT LEAST ONE TARGET PERFORMANCE METRIC WITHIN THE RESPONSE PACKET
242
PERFORM THE OPERATION OF FORWARDING THAT RESPONSE PACKET OF THE RESPONSE PACKET GROUP TO THE INITIATOR AGENT

FIG. 6

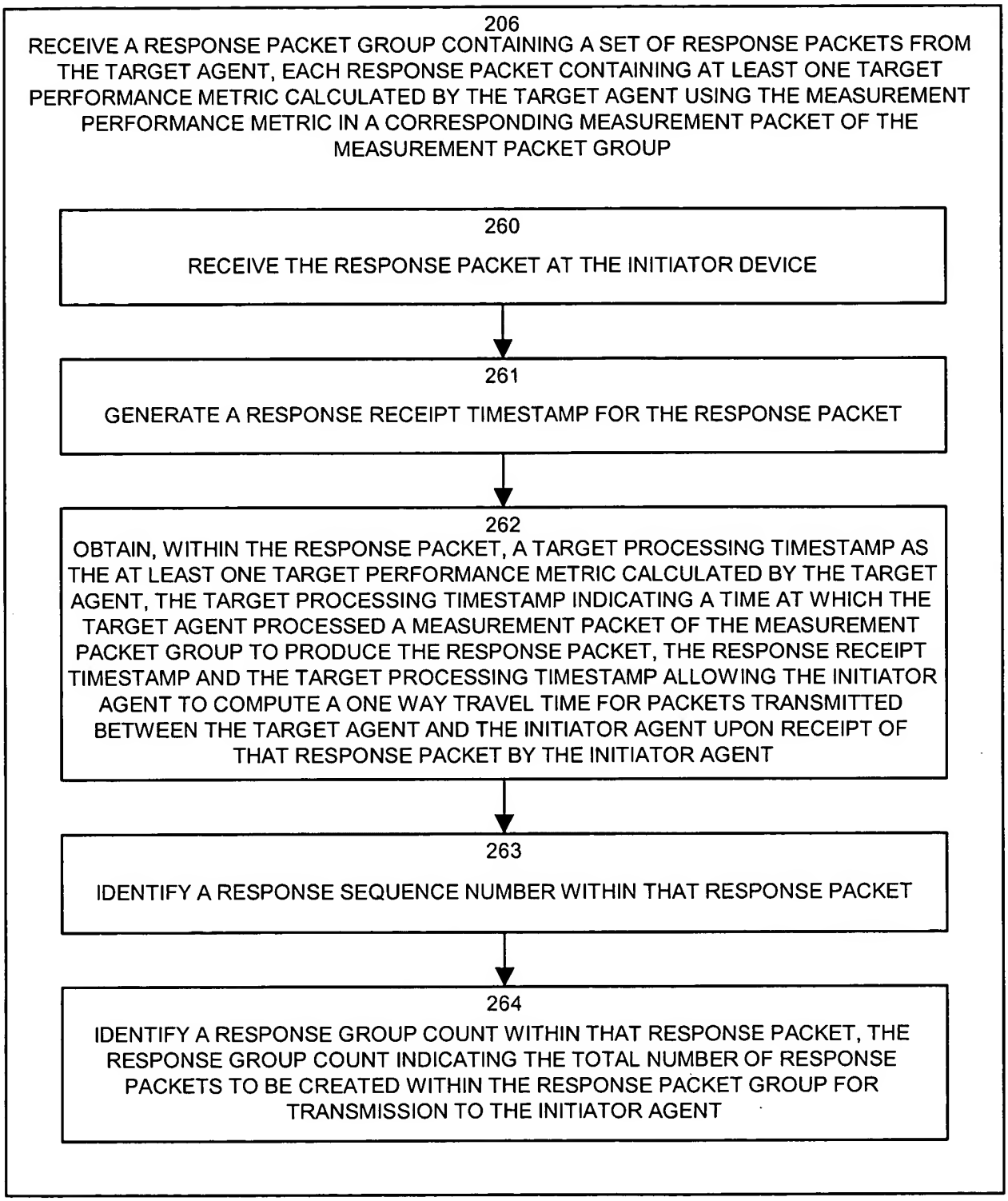
206
RECEIVE A RESPONSE PACKET GROUP CONTAINING A SET OF RESPONSE PACKETS FROM THE TARGET AGENT, EACH RESPONSE PACKET CONTAINING AT LEAST ONE TARGET PERFORMANCE METRIC CALCULATED BY THE TARGET AGENT USING THE MEASUREMENT PERFORMANCE METRIC IN A CORRESPONDING MEASUREMENT PACKET OF THE MEASUREMENT PACKET GROUP
260
RECEIVE THE RESPONSE PACKET AT THE INITIATOR DEVICE
261
GENERATE A RESPONSE RECEIPT TIMESTAMP FOR THE RESPONSE PACKET
262
OBTAIN, WITHIN THE RESPONSE PACKET, A TARGET PROCESSING TIMESTAMP AS THE AT LEAST ONE TARGET PERFORMANCE METRIC CALCULATED BY THE TARGET AGENT, THE TARGET PROCESSING TIMESTAMP INDICATING A TIME AT WHICH THE TARGET AGENT PROCESSED A MEASUREMENT PACKET OF THE MEASUREMENT PACKET GROUP TO PRODUCE THE RESPONSE PACKET, THE RESPONSE RECEIPT TIMESTAMP AND THE TARGET PROCESSING TIMESTAMP ALLOWING THE INITIATOR AGENT TO COMPUTE A ONE WAY TRAVEL TIME FOR PACKETS TRANSMITTED BETWEEN THE TARGET AGENT AND THE INITIATOR AGENT UPON RECEIPT OF THAT RESPONSE PACKET BY THE INITIATOR AGENT
263
IDENTIFY A RESPONSE SEQUENCE NUMBER WITHIN THAT RESPONSE PACKET
264
IDENTIFY A RESPONSE GROUP COUNT WITHIN THAT RESPONSE PACKET, THE RESPONSE GROUP COUNT INDICATING THE TOTAL NUMBER OF RESPONSE PACKETS TO BE CREATED WITHIN THE RESPONSE PACKET GROUP FOR TRANSMISSION TO THE INITIATOR AGENT

FIG. 7

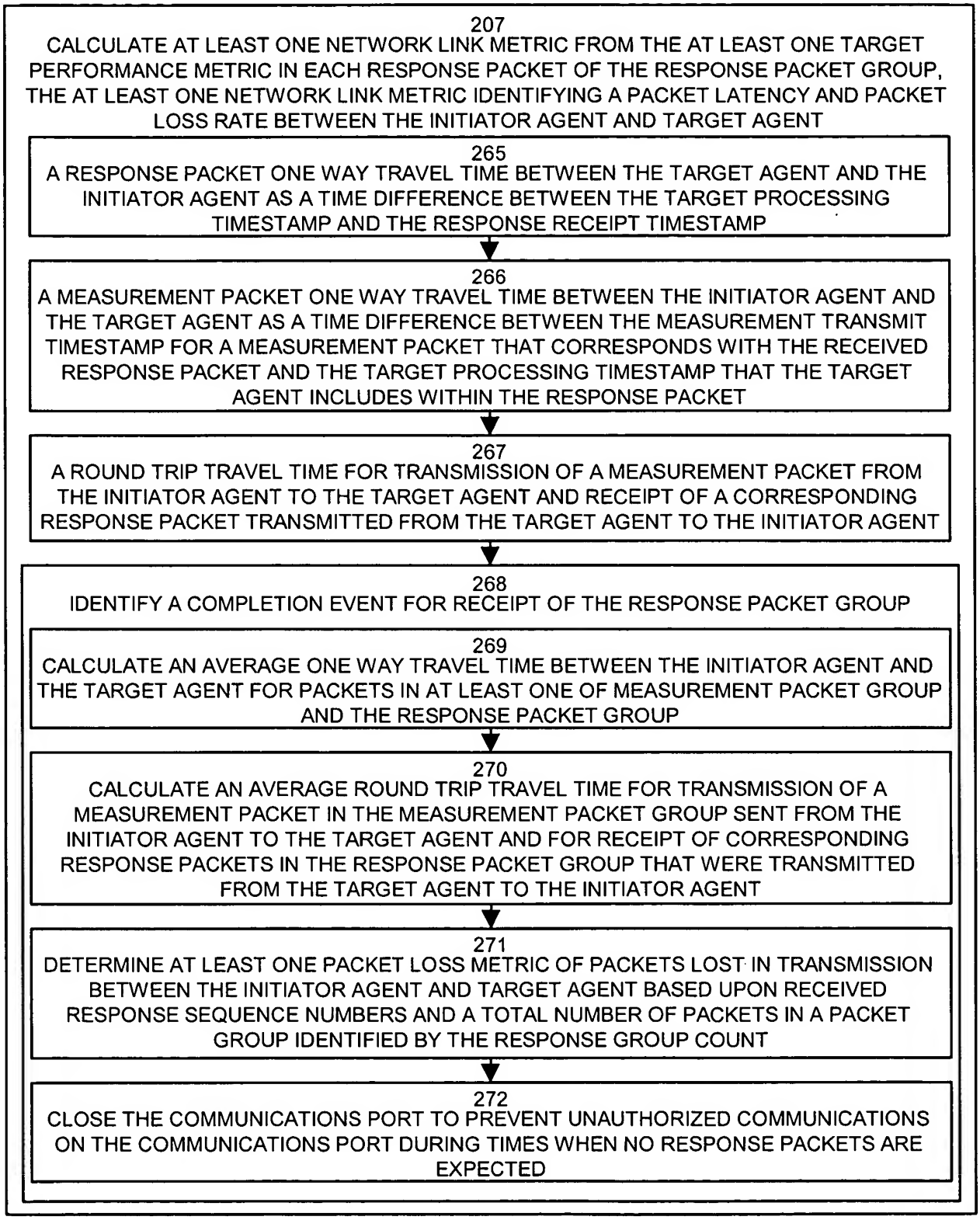
207
CALCULATE AT LEAST ONE NETWORK LINK METRIC FROM THE AT LEAST ONE TARGET PERFORMANCE METRIC IN EACH RESPONSE PACKET OF THE RESPONSE PACKET GROUP, THE AT LEAST ONE NETWORK LINK METRIC IDENTIFYING A PACKET LATENCY AND PACKET LOSS RATE BETWEEN THE INITIATOR AGENT AND TARGET AGENT
265
A RESPONSE PACKET ONE WAY TRAVEL TIME BETWEEN THE TARGET AGENT AND THE INITIATOR AGENT AS A TIME DIFFERENCE BETWEEN THE TARGET PROCESSING TIMESTAMP AND THE RESPONSE RECEIPT TIMESTAMP
266
A MEASUREMENT PACKET ONE WAY TRAVEL TIME BETWEEN THE INITIATOR AGENT AND THE TARGET AGENT AS A TIME DIFFERENCE BETWEEN THE MEASUREMENT TRANSMIT TIMESTAMP FOR A MEASUREMENT PACKET THAT CORRESPONDS WITH THE RECEIVED RESPONSE PACKET AND THE TARGET PROCESSING TIMESTAMP THAT THE TARGET AGENT INCLUDES WITHIN THE RESPONSE PACKET
267
A ROUND TRIP TRAVEL TIME FOR TRANSMISSION OF A MEASUREMENT PACKET FROM THE INITIATOR AGENT TO THE TARGET AGENT AND RECEIPT OF A CORRESPONDING RESPONSE PACKET TRANSMITTED FROM THE TARGET AGENT TO THE INITIATOR AGENT
268
IDENTIFY A COMPLETION EVENT FOR RECEIPT OF THE RESPONSE PACKET GROUP
269
CALCULATE AN AVERAGE ONE WAY TRAVEL TIME BETWEEN THE INITIATOR AGENT AND THE TARGET AGENT FOR PACKETS IN AT LEAST ONE OF MEASUREMENT PACKET GROUP AND THE RESPONSE PACKET GROUP
270
CALCULATE AN AVERAGE ROUND TRIP TRAVEL TIME FOR TRANSMISSION OF A MEASUREMENT PACKET IN THE MEASUREMENT PACKET GROUP SENT FROM THE INITIATOR AGENT TO THE TARGET AGENT AND FOR RECEIPT OF CORRESPONDING RESPONSE PACKETS IN THE RESPONSE PACKET GROUP THAT WERE TRANSMITTED FROM THE TARGET AGENT TO THE INITIATOR AGENT
271
DETERMINE AT LEAST ONE PACKET LOSS METRIC OF PACKETS LOST IN TRANSMISSION BETWEEN THE INITIATOR AGENT AND TARGET AGENT BASED UPON RECEIVED RESPONSE SEQUENCE NUMBERS AND A TOTAL NUMBER OF PACKETS IN A PACKET GROUP IDENTIFIED BY THE RESPONSE GROUP COUNT
272
CLOSE THE COMMUNICATIONS PORT TO PREVENT UNAUTHORIZED COMMUNICATIONS ON THE COMMUNICATIONS PORT DURING TIMES WHEN NO RESPONSE PACKETS ARE EXPECTED

FIG. 8